Redoximorphic Features

"Redoximorphic Features for Identifying Aquic Conditions", Technical Bulletin 301
NCSU, Raleigh, North Carolina.
Order from: Dept. of Ag. Comm., Box 7603, NCSU, Raleigh, NC 27695-7603
(919)-513-3173 $5 / copy.

Objectives

Upon completion of this section, participants will be able to:

- Explain how redoximorphic features form
- Identify and describe redoximorphic features
- Understand the use of a,a'-dipyridyl to confirm soil reduction

References

- Vepraskas, M.J. 1995(revised). Redoximorphic Features for Identifying Aquic Conditions. Tech. Bull. 301, North Carolina State University, Raleigh, NC.
- Mitsch, W.J. and J.G. Gosselink. 1986. Wetlands. Van Nostrand Reinhold, New York, NY. pp 88 - 105.
- Soil Survey Staff. 1993. Soil Survey Manual. USDA Handbook No. 18. pp 146 - 157.

Formation of Redoximorphic Features

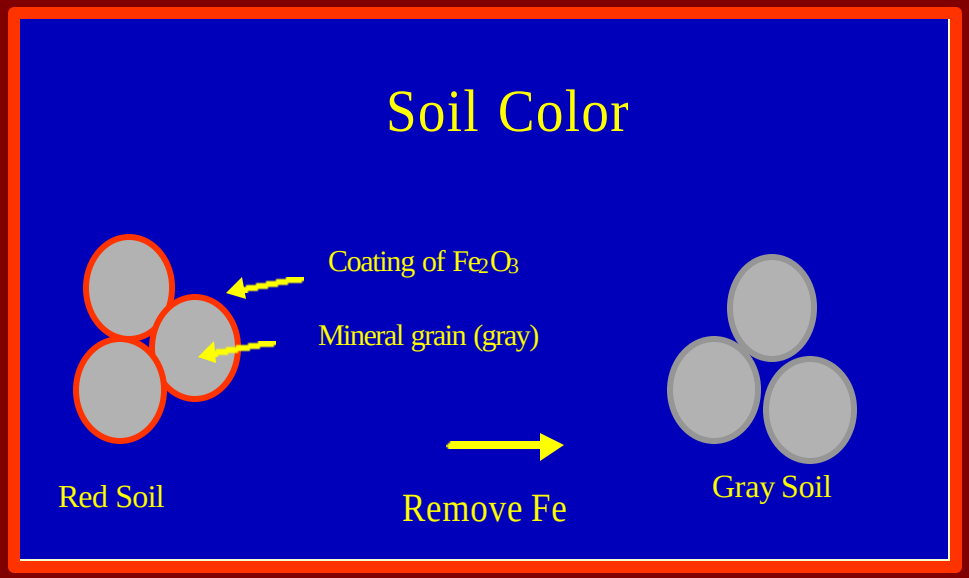
- Anaerobic conditions
  - soil is saturated so most all pores are filled with water, absence of oxygen
- Prolonged anaerobiosis
  - changes the chemical processes in the soil
- Reduction of Fe and Mn oxides
  - results in distinct soil morphological characteristics
    - most are readily observable changes in soil color

Reduction Sequence

+350	mV	Oxygen	O_2	⌫	H_2O
+220	mV	Nitrogen	NO_3-	⌫	$N_2\uparrow$; NH_4^+
+200	mV	Manganese	Mn^{+4}	⌫	Mn^{+2}
+120	mV	Iron	Fe^{+3}	⌫	Fe^{+2}
-150	mV	Sulfur	SO_4^{-2}	⌫	H_2S
-250	mV	Carbon	CO_2	⌫	CH_4

Soil Color and Oxidation / Reduction

- In subsoil horizons, Fe and Mn oxides give soils their characteristic brown, red, yellow colors
- When reduced, Fe and Mn are mobile and can be stripped from the soil particles
- Leaving the characteristic mineral grain color
  - usually a “grayish” color



Redox Concentrations

A review of formation

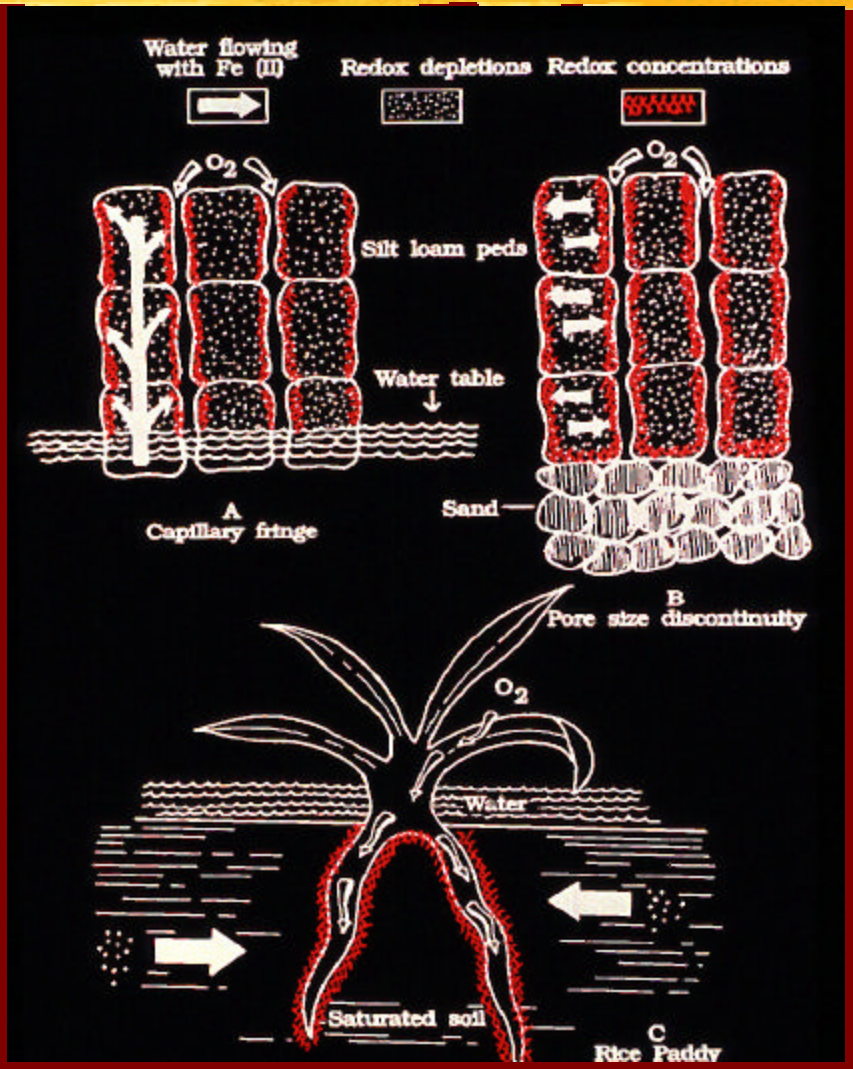


Fig. 9 from Vepraskas 1995

Types of Redoximorphic Features

- Redox Concentrations
  - Masses
  - Pore Linings
  - Nodules and Concretions
- Redox Depletions
  - Depleted Matrix
- Reduced Matrix

Redox Concentrations

- Bodies of apparent accumulation of Fe-Mn oxides
  - Masses
  - Pore Linings
    - ped faces
    - root channels
  - Nodules and Concretions

Soft Masses

- Soft bodies
  - frequently in the soil matrix
  - variable shape
  - can usually be removed from the soil “intact”

Soft Masses in Sand

- The masses have diffuse reddish boundaries

Pore Linings

- Zones of accumulation
  - coatings on a pore surface
  - impregnation's of the matrix adjacent to the pore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Nodules and Concretions

- Firm to extremely firm bodies
  - often relict
  - should be irregular shape
  - diffuse boundary
    - "halo" or "corona"

Redox Depletions

- Bodies of low chroma where Fe-Mn oxides have been stripped out
  - generally value ≥ 4
  - chroma ≤ 2
  - formerly called "gray mottles"

Depleted Matrix

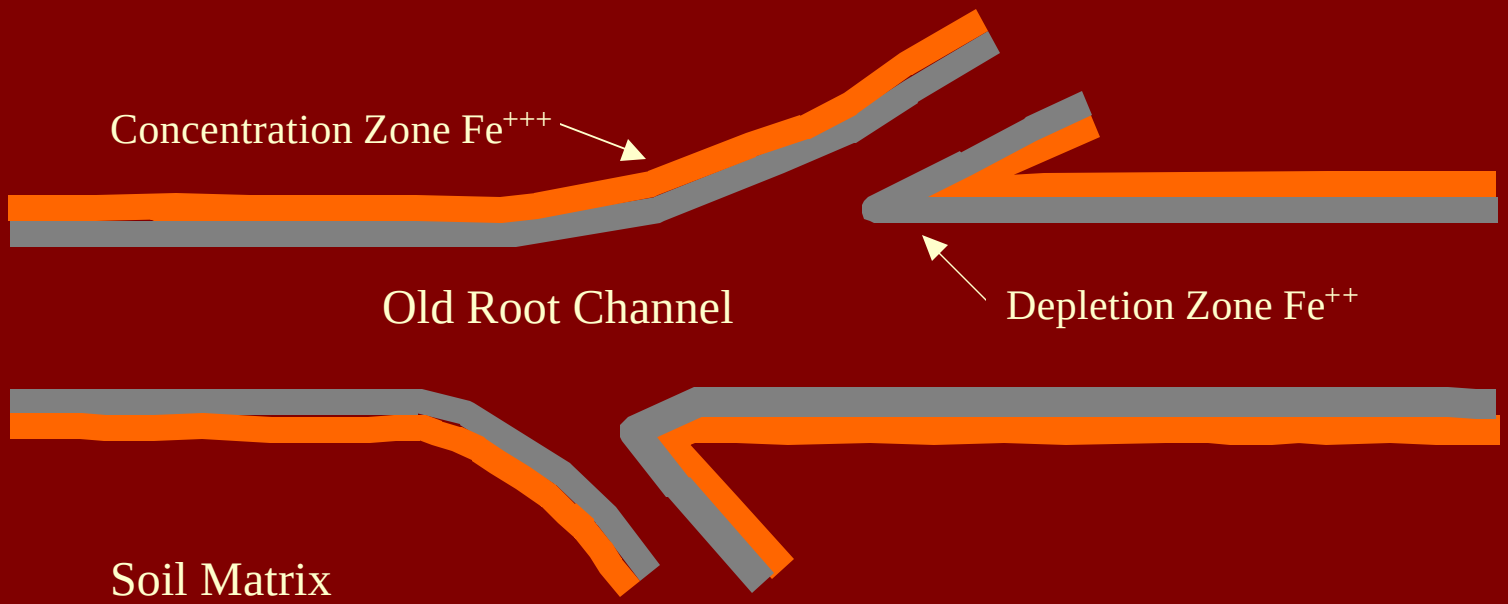
- Dominant color of the soil is “gray”
- Commonly used to identify hydric soils
  - Discussed more in hydric indicators section

Reduced Matrix

- Soils have high value, low chroma in situ but color changes when exposed to air
  - reduced Fe is present
  - Fe^{+2} is oxidized to Fe^{+3} upon exposure

Redox Depletions

A review of formation



Formation of redox depletions and concentrations along root channels

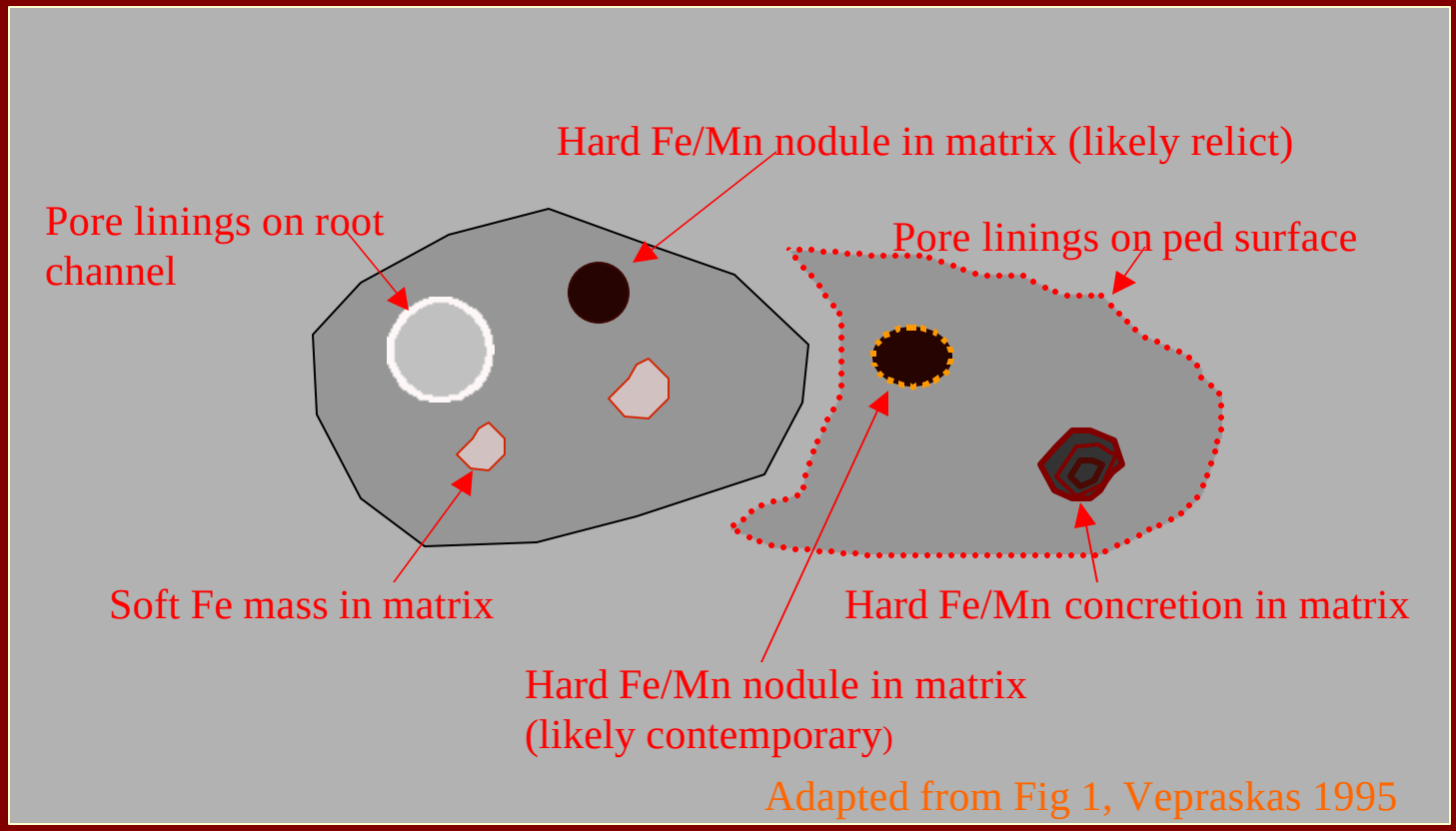
a, a' - Dipyridyl

- A dye used to test for the presence of reduced Fe
  - pink reaction to Fe^{+2}
  - dye sensitive to light and heat
  - apply to freshly broken open soil ped

Describing Redoximorphic Features

- Concentrations and Depletions
  - Describe type, color, abundance and location (i.e. along macropores or within matrix)
    - contrast can be obtained from color charts
- Reduced Matrix
  - Describe reduced matrix color, oxidized color, and time for color change to occur
- a a' - Dipyridyl
  - Describe % of soil that reacts and location

Redox Concentrations



Schematic illustration showing different kinds of redox concentrations and their relationship to soil macropores and matrices

Interpretation Problems

Redoximorphic features do not occur in all soils

- Low amounts of soluble Organic Carbon
- High pH
- Cold temperatures
- Low amounts of Fe
- Aerated groundwater

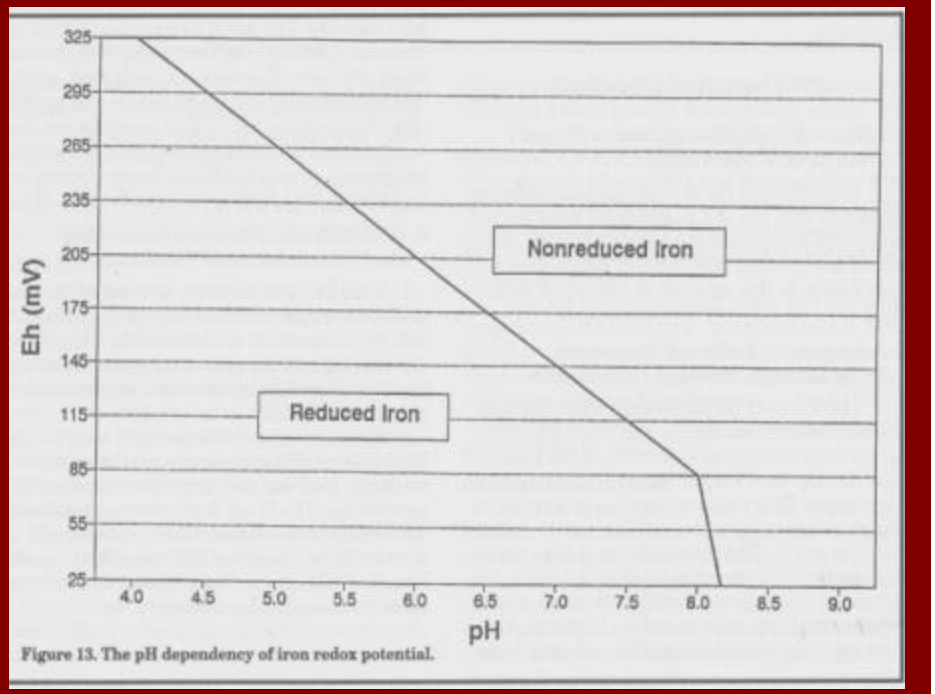


Figure 13. The pH dependency of iron redox potential.

Rate of Feature Formation

- A 2 mm thick Fe depletion around a root channel ranged from less than 1 to greater than 100 years depending upon how long reducing conditions occurred and how much Fe was in solution each day
  - Recently constructed wetlands should have redox depletions evident within a couple of years if wetland hydrology is present during the “growing season”

Age of Features

- Redox features do not always indicate current hydrologic condition
  - commonly found in drained (historic) wetlands
  - can be relict of past climates
    - terraces in LMV, Texas Coastal Prairie
    - relict features may have sharp edges and abrupt boundaries with the soil
      - relict nodules and concretions are often rounded
  - contemporary features should have diffuse boundaries and / or be associated with ped faces or root channels

Relict vs Contemporary

Relict

Contemporary

Relict features are often firm to extremely firm and have abrupt boundaries with the soil matrix

Quiz time